

REMARKS

Preliminarily, Applicants appreciate that the Examiner has acknowledged receipt of the certified copy of the foreign priority document. The priority document was filed in grandparent application No. 09/839,398. This is not a national stage application.

Claims 14, 17 and 23 have been amended to recite that the niobium granular has an average particle size of from about 1 to 300 μm (support at page 7, lines 3-5 of the specification), and to further incorporate therein the recitation of claim 20 (the niobium powder is obtained by granulating a niobium powder having an average primary particle size of about 1 μm or less). Claims 20, 21 and 22 have been canceled.

Support for new claims 32-35 is found, for example, at page 5, lines 17-19 of the specification.

Entry of the amendments and review and reconsideration on the merits are requested.

Claims 14-24 and 28-32 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,171,363 to Shekhter et al. The Examiner cited Shekhter et al as meeting the terms of the rejected claims, including a nitrided niobium powder containing less than 200 ppm Ta, citing Table 10.1 at column 10, which powder is used in either primary or secondary form for forming a capacitor anode (citing column 4, lines 47-61). Shekhter et al was further cited as teaching the method as claimed, including sintering under vacuum (i.e., reduced pressure) at 1200°C for 20 minutes, citing column 7, lines 13-14, and that agglomeration can be achieved by thermal and/or physical means within the scope of claims 30-32.

Applicants traverse, and respectfully request the Examiner to reconsider in view of the amendments to the claims and the following remarks.

The present invention provides a niobium sintered body, method for making the same and capacitor including an electrode comprising the niobium sintered body. The sintered body comprises a niobium granule which comprises niobium and tantalum, where tantalum is present in an amount of at most 700 ppm by mass. Furthermore, the niobium granule has an average particle size of about 1 to 300 μm obtained by granulating a niobium powder having an average primary particle size of about 1 μm or less.

The present invention provides a niobium sintered body and capacitor using the same which is not susceptible to a reduction in CV value (specification bridging pages 2-3).

Turning to the cited prior art, the niobium powder used to prepare Example 10 of Shekhter et al (having a Ta content of < 200 ppm) was a non-agglomerated powder. Particularly, there is no anticipation of the claims originally presented for examination for the reason that Shekhter et al does not disclose a single working example of a sintered niobium granule having a Ta content of 700 ppm or less.

To further distinguish over the applied prior art, claims 14, 17 and 23 have been amended to define the niobium granule as having an average particle size of from about 1 to about 300 μm , which granule is obtained by granulating a niobium powder having an average primary particle size of about 1 μm or less. Although Shekhter et al may perhaps suggest the use of an agglomerated powder, which agglomerated powder may constitute agglomerates of 3 to several thousand primary particles, Shekhter et al has no disclosure with regard to the requisite primary

particle size of the starting niobium powder, or the average particle size of the resulting niobium granule for obtaining a sintered body having enhanced electrical characteristics.

For example, the sintered pellet of Example 10 of Shekhter et al having a Ta content of < 200 ppm (which was not prepared by granulating a niobium powder) exhibited a capacitance ranging from 11,300 to 68,000 $\mu\text{F (V)}/\text{gm}$, whereas the sintered body of Example 1 of the present specification (Table T1 at page 12) having a Ta content of 200 ppm and sintered at a temperature of 1150°C for 100 minutes exhibited a CV of 120,000 $\mu\text{F (V)}/\text{gm}$. Notably, all of the working Examples of the present application were prepared by granulating a niobium powder. That is, Shekhter et al did not recognize that granulation of a niobium powder having a low Ta content provides a remarkably enhanced CV value, let alone significance of the average primary particle size of the starting niobium powder and average primary particle size of the granulated powder.

Additionally, Applicants also traverse the Examiner's assertion that Shekhter et al discloses the limitations of claims 30-32 (niobium granule obtained by standing niobium powder at high temperature to obtain a coagulation-solidified powder and then cracking the coagulation-solidified powder). Shekhter et al merely suggest that agglomeration can be accomplished by a variety of thermal and/or physical means, but gives no specific techniques or methods, other than suggesting that "well known methods" may be used. This is not a specific disclosure of present claims 30-32.

Applicants further comment on the differences between the present invention and Shekhter et al as follows.

The niobium powder of Shekhter et al is obtained by reducing Nb_2O_5 with Mg gas.

This powder is already agglomerated when produced (see, Fig. 8B and Example 8). Accordingly, unlike the present invention, in Shekhter et al there is no need to granulate a primary particle powder into a secondary particle powder. Furthermore, one of ordinary skill would understand that the powder of Example 10 is likewise already agglomerated.

If this powder is further agglomerated by the known method described in col. 4, lines 47-63, an agglomerated powder (tertiary particle powder) is obtained.

In the case of the powder of Shekhter et al, as read from the dimension of Fig. 8B or from the description in col. 9, line 20 (magnification: 700 times), the particle size of the powder corresponding to the primary particle powder of the present invention is about 20 nm. When a sintered body is produced by using a niobium powder resulting from agglomeration of a powder having such a particle size (about 20 nm) and electrochemically converted to form a dielectric layer, the thickness of the dielectric layer formed on the primary powder surface becomes larger than 20 nm and the metal niobium in this portion is lost.

That is, in the sintered body, most of the primary particle powder portions are lost.

The above is demonstrated in Table 1, "Oxide thickness at 25°C" of the paper by N.F. Jackson et al (Electrocomponent Science and Technology, Vol. 1, pp. 27-37 (1974)) attached hereto. In the case of a niobium dielectric layer, the thickness of the dielectric layer is determined by the electrochemical forming voltage. The oxide thickness is about 25 \AA/V (2.5 nm/V) and since the electrochemical forming voltage in Example 10 of Shekhter et al is 16 V (see, col. 10, line 10), the dielectric layer thickness can be calculated as follows.

$$2.5 \text{ nm} \times 16 = 40 \text{ nm}$$

The dielectric layer is formed over the entire surface of the powder and therefore, the thickness of the dielectric layer is 80 nm. The data in the paper is a value at 25°C but the electrochemical forming temperature in Example 10 of Shekhter et al is 80°C (see, col. 10, line 10) and therefore one skilled in the art can expect that the layer thickness to become even larger.

In this manner, when such a sintered body is used as the anode of a capacitor, most of the primary particle powder portions are lost.

Furthermore, in the sintered body stage, the CV value is as small as 8,000 $\mu\text{FV/g}$ (sintered at 1,250°C) despite a very large surface area of the powder of 22,000 cm^2/g (see, col. 10, line 6), and the CV value greatly decreases even by slight elevation of the sintering temperature (see, Table 10.2). This reveals that the primary particle powder is melted and lost depending on the temperature at sintering.

As verified above, the sintered body of Shekhter et al greatly differs from the sintered body of the present invention with respect to internal structure. Namely, the sintered body of Shekhter et al comprises mostly only secondary particle powder portions and is lacking in primary particle powder portions, whereas the sintered body of the present invention comprises a niobium granule having an average particle size of from about 1 to 300 μm obtained by granulating a niobium powder having an average primary particle size of about 1 μm or less.

In summary, the present claims, even as originally presented, are not anticipated because Shekhter et al does not disclose a single working example of a sintered niobium granule having a Ta content of 700 ppm or less. Furthermore, even though Shekhter et al may suggest the use of

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an agglomerated powder, Shekhter et al has no disclosure with regard to the requisite primary particle size of the starting niobium powder or the average particle size of the resulting niobium granule for obtaining a sintered body having enhanced electrical characteristics. The subject disclosure in Shekhter et al is not of sufficient specificity to constitute an anticipation nor lead one of ordinary skill in the art to arrive at the invention. Moreover, as shown above in reference to the paper by Jackson et al, the sintered body of Shekhter et al has an internal structure which differs greatly from that of the present invention.

For the above reasons, it is respectfully submitted that the present claims are not anticipated by Shekhter et al, and withdrawal of the foregoing rejection under 35 U.S.C. § 102(e) is respectfully requested.

Claims 25-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shekhter et al in view of EP 0953847 (EP '847). EP '847 was cited as disclosing a capacitor having an electrode meeting the terms of the rejected claims.

Applicants rely on the response above with respect to the rejection of Shekhter et al alone.

Claims 14-19 and 23-29 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 3 and 4 of U.S. Patent 6,540,810.

Applicants respectfully traverse for the following reasons.

Claim 3 of U.S. '810 defines a sintered body comprising a partially nitrided niobium powder having a Ta content of at most 700 ppm by mass. Claim 4 of U.S. '810 is similar to

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process claim 17 as originally presented for examination. However, the present claims require sintering a niobium granule or niobium granule compact, which limitation is not disclosed by the claims of U.S. '810. Moreover, the present claims require a niobium granule having an average particle size of from about 1 to about 300 μm obtained by granulating a niobium powder having an average primary particle size of about 1 μm or less, which limitation is also not disclosed by the claims of U.S. '810.

For the above reasons, it is respectfully submitted that claims 14-19 and 23-29 are not obvious over claims 3 and 4 of U.S. '810, and withdrawal of the obviousness-type double patenting rejection is respectfully requested.

Withdrawal of all rejections and allowance of claims 14-19 and 23-35 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

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